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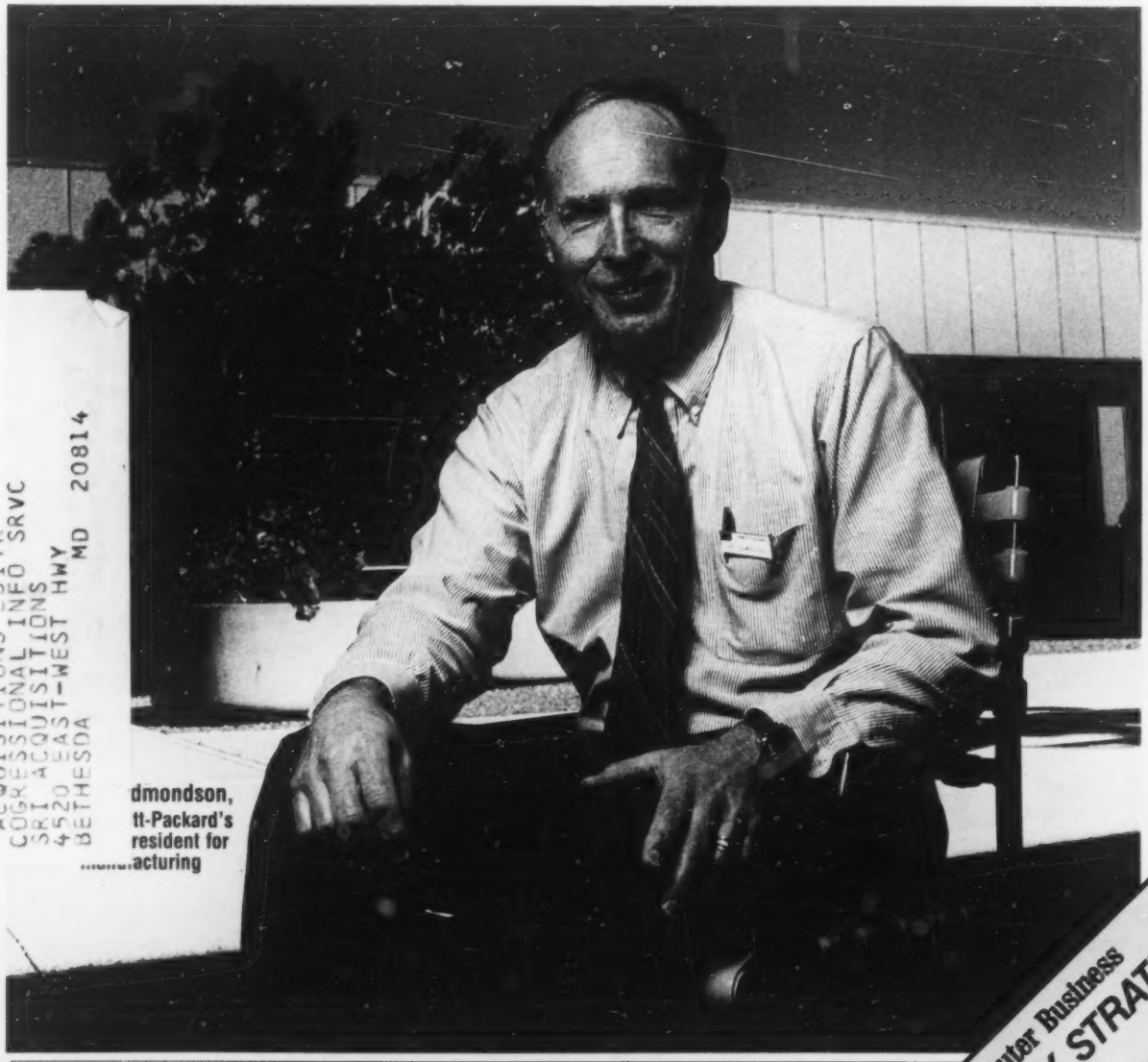
These are glory days for SMT production gear firms PAGE 74

IBM-clone chip sets: The new industry money-makers PAGE 30



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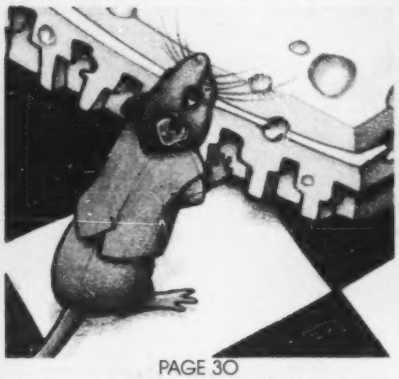
Why tomorrow's manufacturing exec needs corporate savvy *and* technical skills PAGE 54

Computer Business
IBM's UNIX STRATEGY
PAGE 94

Electronic Business

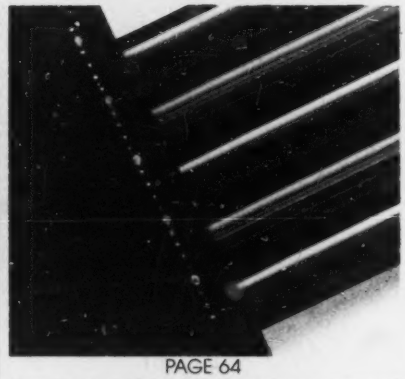
VOL. 14, NO. 8 APRIL 15, 1988

THE BUSINESS MAGAZINE FOR MANAGEMENT IN ELECTRONICS, COMPUTER AND SYSTEMS COMPANIES



PAGE 30

PAGE 54



PAGE 64

BUSINESS TRENDS

30 While the fat cat's been away, the mice have played
Newcomers have run off with a rich market: IBM-clone chip sets. But the old guard's awakening.

34 Why CVD is the new VIP: Very Important Process
Developments in chemical vapor deposition should almost treble sales of semiconductor CVD equipment by 1992.

38 Want hot technology? It's free—from Star Wars
The Pentagon office that plans to protect you from nuclear attack is now offering you access to its unclassified R&D.

42 WORM drives wriggle toward acceptance
Despite their lack of data-interchange standards, sales of write-once optical memory drives should double by 1990.

44 Why HP won't easily get burned on safety issues
Hewlett-Packard makes safety a top priority throughout the company—and has the gadgets and the audits to prove it.

48 Swiss die-bonder aims for automated chip lines
Third-ranking maker of automated die-bonding machines for IC packaging lines, ESEC is pushing into the U.S. and Japan.

MANAGEMENT

54 Why manufacturing execs need corporate savvy, too
CIM and JIT will only take competitiveness so far. What U.S. electronics firms need now is a new breed of manufacturing pro.

COMPUTER BUSINESS

92 Painting Unix blue: How IBM stoops to conquer
The Unix operating system is supposed to make users like GM and the U.S. government supplier-independent. IBM has other ideas.

104 Laser printers: Too many vendors drive prices down
Laser printer vendors will sell more units this year, but they face further price erosion and a crowded marketplace.

110 The 386 gives Unix board makers muscle
The market is small but about a dozen companies have rushed in to fill a void left by the larger add-in board manufacturers.

120 Control Data cashes in on a captive operation
CDC is turning its internal expertise in thin-film heads for disk drives into a thriving OEM business.

MARKETS

64 The connector consensus: Growth, but more shakeout
Connector makers see a double-digit uptick this year. The big question is whether a downturn hits next year—or late in '88.

74 These are glory days for SMT production gear firms
They're finally seeing backlogs swell as America embraces SMT. The users' main problem is what to buy, and from whom.

84 Motorola and NEC gear up for a car phone clash in Europe
Their joint domination of Europe's cellular phone market could end with a 1991 debut of standards for digital cellular networks.

DEPARTMENTS

4 Inside Business

9 Update

17 Business Barometer: Mark, Mark Twain, mark modems.

124 Plant Sites: Seattle's electronics firms team up to train their workers.

126 Editorial Index

130 Viewpoint: Skip the front page, and ignore recession talk.

AN EDITORIAL INDEX OF ALL COMPANIES DISCUSSED IN THIS ISSUE CAN BE FOUND ON PAGE 126

Cover photo: Cindy Charles

ELECTRONIC BUSINESS® (ISSN 0163-6197) is published semi-monthly, except monthly in December, by The Cahners Publishing Company, A Division of Reed Publishing USA, 275 Washington Street, Newton, MA 02158-1630. Terrence M. McDermott, President; Frank Sibley, Group Vice President; Jerry D. Neth, Vice President/Publishing Operations; J.J. Walsh, Financial Vice President/Magazine Division; Thomas J. Dellamaria, Vice President/Production and Manufacturing. Circulation records are maintained at Cahners Publishing Company, 44 Cook Street, Denver, CO 80206-5191. Telephone: (303)388-4511. Second-class postage paid at Denver, CO 80206-5191 and additional mailing offices. POSTMASTER: Send address corrections to ELECTRONIC BUSINESS® at the Denver address. ELECTRONIC BUSINESS® copyright 1988 by Reed Publishing USA; Saul Goldweitz, Chairman; Ronald G. Segel, President/C.E.O.; Robert L. Krakoff, Executive Vice President; William M. Platt, Senior Vice President. Annual subscription rates for non-qualified people: USA/Canada/Mexico, $55 per year; other countries, $85 per year (including air freight), $170 per year for air mail. Except for special issues where price changes are indicated, single copies of regular issues are available for $6.00, $8.00 and $10.00 (USA, Canada/Mexico and foreign). Please address all subscription mail to Eric Schmierer, 44 Cook Street, Denver, CO 80206-5191. Cahners Publishing Company, A Division of Reed Publishing USA • Specialized Business Magazines for Building & Construction • Manufacturing • Foodservice & Lodging • Electronics & Computers • Interior Design • Printing • Publishing • Industrial Research & Technology • Health Care • Entertainment. Specialized Consumer Magazines: American Baby • Modern Bride.

VBPA ABP

Mark, Mark Twain, mark modems

Reports of their death are highly exaggerated. Will videotex give modems their next lease on life?

Eighteen years ago, after the FCC allowed MCI to compete with AT&T, Datran got approval for an all-digital network. Industry pundits then predicted the demise of the modem business, which was owned by AT&T, and had attracted a small but growing crop of start-ups such as Milgo, Paradyne and Penril. Modems allow the analog phone network to transmit digital signals.

Today, Datran is defunct and modems are mushrooming, but the ever-tightening bonds between computers and communications continue to cast a shadow on the modem's future. Like Mark Twain, modem companies by now are so used to reading about their own premature death that their obituaries must sound like a sticky tune in their ears.

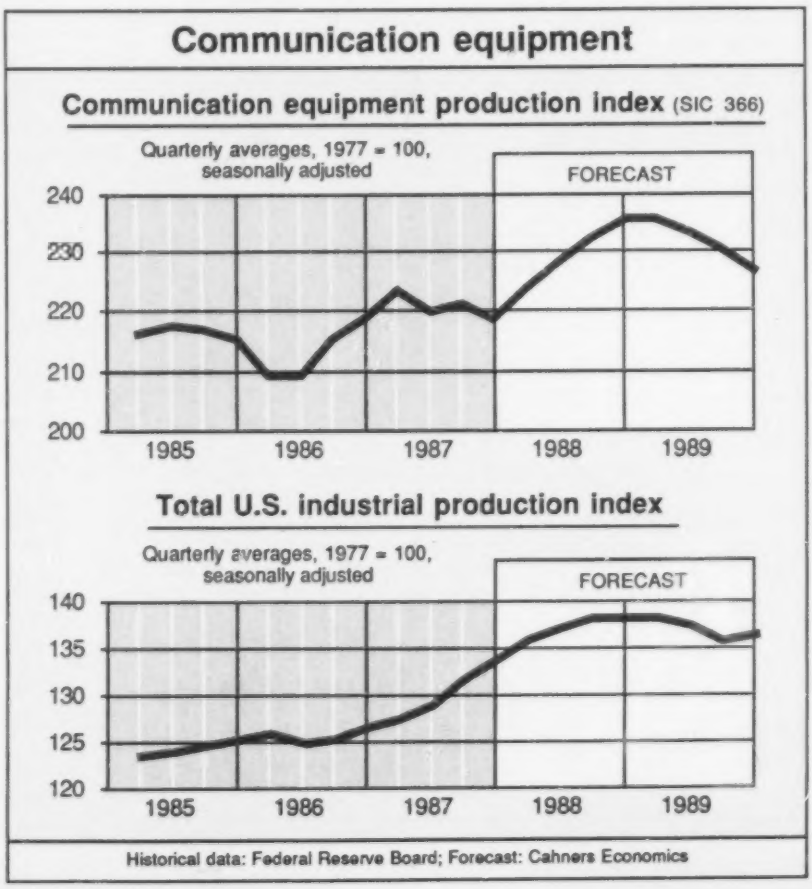
There is a less obvious threat: modems get cheaper all the time. The old modem companies have expanded into datacommunications and network management equipment. The younger manufacturers, however, which make their money from people who connect PCs to the telephone network, are very much affected. "Hayes' unit sales have grown 30% in 1987, but their revenue remained relatively flat at $120 million plus," says Richard L. Villars, senior market analyst at International Data Corp., about the leading manufacturer of modems for PCs.

Hayes Microcomputer Products Inc. will provide 1,200-baud duplex modems for Trintex's videotex service. This 4-year-old joint venture of IBM and Sears, Roebuck & Co. has been testing its Prodigy Interactive Personal Service since November. The venture hopes to serve, over telephone lines and MCI's network, a million PC users nationwide by the early 1990s. Videotex has not caught on in the U.S. "There is no market for interactive services over cable," says John C. Malone, president and CEO of Tele-Communications Inc. (TCI), the largest operator of multiple cable systems in this country, "not until fiber optics makes two-way communications cheaper."

IDC's Villars says that opportunities such as videotex are already factored in his no-growth forecast for the 1,200-baud full-duplex modem worldwide market at $230 million for 1988. He does predict growth of 15% for the 2,400-baud market, noting that Hayes may be called to provide the higher data rate modems. Indeed, Rockwell Int'l Semiconductor Products Div., which Villars ranks as the largest supplier of modem chips and as Hayes' major vendor, sells more of the higher speed chips. "We surpassed a million of the 2,400-baud full-duplex chips [after two years] last October," says Rockwell's modem product manager Dudley Westlake.

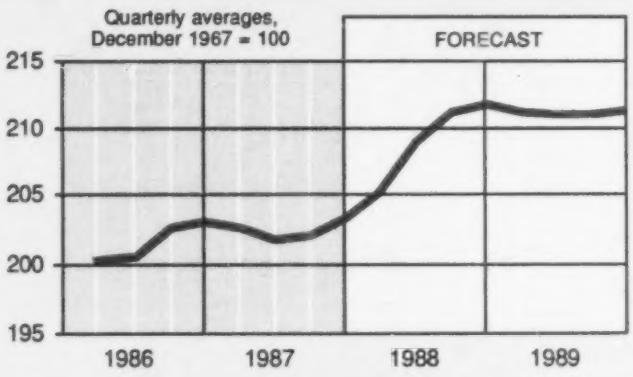
Since Hayes' modems are made in the U.S., they contribute to the index of industrial production for communications equipment. However, this index is heavily weighted with military communications equipment, which is the reason Cahners senior economist Elizabeth Baatz forecasts only a 4% growth for this year. Even without videotex, modems should do much better.

ALBERTO SOCOLOVSKY

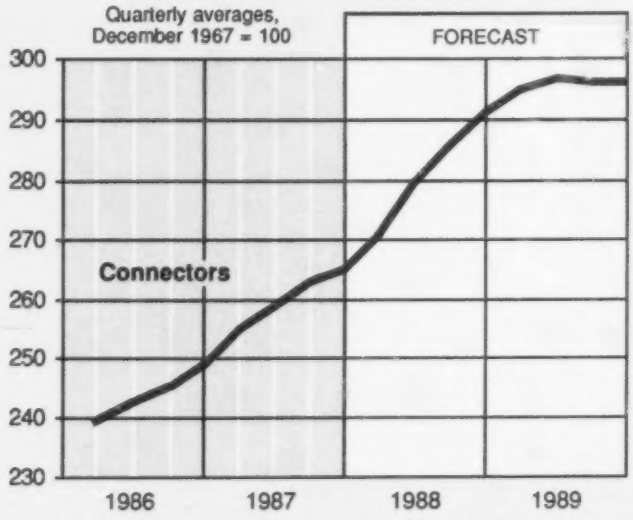


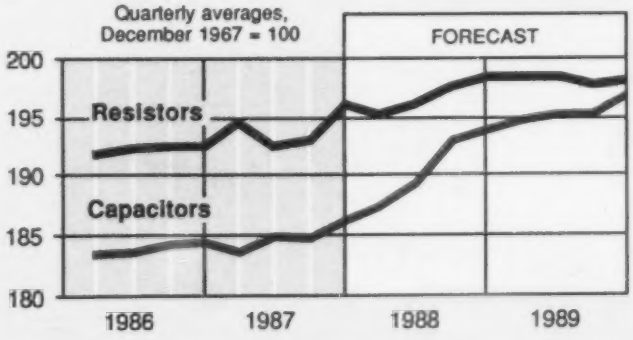
Producer price indexes

Electronic components and accessories (SIC 1178)



Passive components





Historical data: Bureau of Labor Statistics; Forecast: Cahners Economics

Electronic Components
Producer prices for electronic components rose a slight 0.2% in the fourth quarter of 1987 over the comparable quarter in 1986. For 1987, the annual inflation rate for components rose just 0.5%. This was the lowest annual price increase since 1976. In the first half of 1988, prices are beginning to rise more rapidly. By the end of this year, component prices are expected to increase 3.3%, according to Cahners Economics. At the moment, supply-demand pressures for memories and sub-micron components are forcing prices higher. But end-market demand is likely to trail off by the end of 1988 and early 1989, holding further price increases steady.

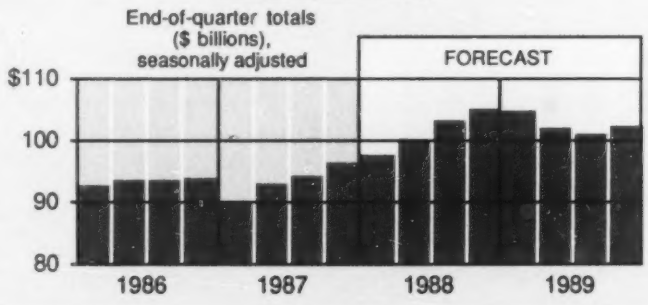
Capacitors
After five years of declines, producer prices of capacitors rose 0.5% in 1987 and are expected to jump 3.2% this year. Much of 1987's price increase came in the final quarter of the year, when prices rose 1% above a year ago. The impetus for price increases comes from rising demand. According to the Electronics Industry Association, U.S. factory sales of capacitors grew over 15% last year. This was the best sales growth since 1984, when capacitors soared 25%.

Resistors
Prices of resistors rose 0.9% in 1987 and are headed for a 1.4% increase this year. These modest price increases are being maintained despite the growing demand from computer and other end markets. Evidence from *Electronics Purchasing's* survey of buyers also shows that supplies of resistors are in relative balance with demand. The length of time from placement of an order to delivery (leadtime), increased 6% in 1987 and is expected to rise another 10% in 1988. But these increases during the tail end of an economic recovery are relatively modest compared with 1984, when resistor leadtimes surged 21%.

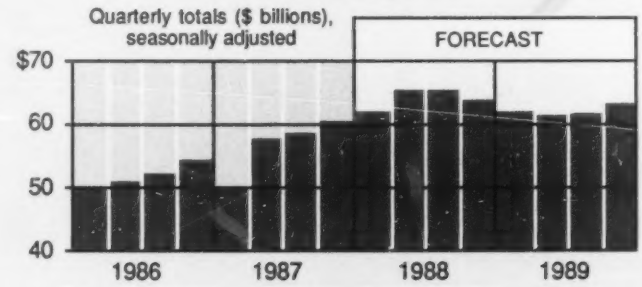
Connectors
Unlike most other passive components, prices of connectors jumped over 6% in the fourth quarter of 1987, compared with the year ago quarter. For the year, connector prices rose at a 6.3% annual rate, almost twice as fast as 1986. Connector prices are expected to continue to accelerate this year, rising another 8.3%. Next year, however, connector inflation will head back down to a more modest 5.3% rate.

Electrical machinery (SIC 36)

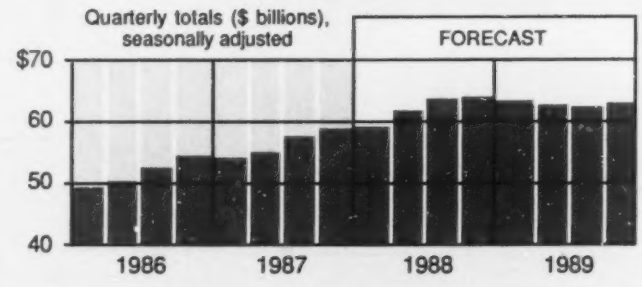
Unfilled orders



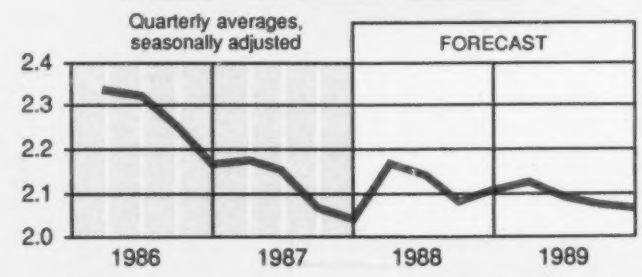
New orders



Shipments



Inventory-to-shipment ratio



Historical data: U.S. Commerce Department; Forecast: Cahners Economics

New orders

New orders for electrical machinery grew 3% in the fourth quarter of 1987 from the prior quarter. This brought total annual orders to $226.2 billion, an increase of $19 billion, or 9.5% over 1986. Of this $19 billion, new orders for electronic components accounted for 46%. Miscellaneous electrical machinery like batteries, electromedical equipment and engines accounted for 27% of the new orders and electrical transmission and distribution equipment accounted for 11%. New orders are expected to grow over 13% this year before falling in 1989.

Unfilled orders

Unfilled orders for electrical machinery topped $96 billion in the final quarter of 1987, $2 billion higher than the third quarter. Most of 1987's increase in unfilled orders was due to an increase in component backlogs. Unfilled orders will continue to rise in 1988 before declining slightly in 1989. But with plenty of factory capacity still available, unfilled orders are not expected to rise above $105 billion. Factory capacity stood at 76.6% in January, still far below the 81.9% peak capacity utilization rate seen in 1984.

Shipments

Rising 1.9% in the fourth quarter of 1987, shipments of electrical machinery totaled $223.9 billion for all of 1987, a 9.4% increase. As with new orders, electronics components and miscellaneous electrical equipment shipments grew fastest, in the 13% to 14% range. Communication equipment shipments rose 6% and TV/radio equipment inched up 2%. With shipments increasing slightly slower than new orders, the book-to-bill ratio for electrical machinery managed to stay above one for the last nine months in 1987. This is the steadiest positive book-to-bill ratio since 1984. A positive book-to-bill ratio is considered a good indicator for the future. Shipments are expected to increase 9.9% this year and 1.3% next year.

Inventory-to-shipment ratio

The inventory-to-shipment (I/S) ratio for electrical machinery dropped just below two in December 1987. Not for over 16 years has this ratio been so low. A 9% increase in shipments in 1987 was met by only a 1% rise in inventories. The uncertain nature of the current economic recovery coupled with computerized inventory management has been causing a long-term downward trend in industrial I/S ratios, while retail and wholesale I/S ratios have taken an upward turn at the end of 1987. For industrial manufacturers, low inventories mean production schedules should continue unhampered this

OPTICAL DRIVES

WORM drives wriggle toward acceptance

Despite their lack of data-interchange standards, sales of write-once optical memory drives should double by 1990

After a slow first few years, the market for optical disk drives is starting to show signs of life, especially the segment for write-once read many times (WORM) devices. Worldwide revenue for WORM drives climbed to $265 million last year and will top the $1 billion mark in 1990, estimates market research firm Freeman Associates Inc. of Santa Barbara, Calif.

Optical drives are finding a niche in computer applications where the sheer bulk of stored data overwhelms conventional magnetic devices. At the low end of the WORM spectrum, 5.25-inch disks can hold upward of 200 megabytes of data. At the high end, 12-inch and 14-inch disks start counting at 1 gigabyte and go up from there. And, since the plastic discs are removable (unlike the platters in conventional Winchester drives), dozens can be stored in optical jukeboxes for quick access at any time.

The main drawback today is that methods are just being perfected to make optical discs erasable. Nevertheless, the more limited write-once format is "perfect for archival applications, especially those that need fast access to data," says Freeman Associates vice president Robert Abraham. In some cases, such as storing legal and financial records, the fact that discs can't be altered is actually an advantage, he notes.

The low end of the optical drive market is dominated by Japanese-made units. Most notable is a 5.25-inch drive made by Matsushita Electric Industrial Co. that computer giant IBM sells for use with its Personal System/2 computers. And disk drive maker Maxtor Corp. of San Jose sells a 5.25-inch drive from Ricoh Company Ltd. — although later this year, it is bringing out an erasable drive it makes itself. U.S. manufacturers include three 4-year-old companies: Laserdrive Ltd. in Santa Clara, Calif; Information Storage Inc. (backed in part by Honeywell Inc. and Japan's Kawasaki Steel) in Colorado Springs; and Optotech Inc., also in Colorado Springs. Another Colorado Springs company, Laser Magnetic Storage International (LMSI — a joint venture between N.V. Philips GL and Control Data Corp.) also recently added a 5.25-inch drive to its higher end product line.

Performance and capacity ceilings for small optical drives are rising, making them more suitable for bigger computers

For the 5.25-inch drives, which have retail prices starting at less than $2,000, "many applications are for storing images, such as CAD/CAM drawings or medical X-rays," says Gordon Knight, director of Maxtor's optical programs. Half of the more than 6,000 drives Maxtor shipped in 1987 went into PC-based systems, he reports. But performance and capacity ceilings for small drives are rising, making them more suitable for bigger computers. For example, Information Storage just introduced a 5.25-inch drive with a 1.28GB capacity that company president Steve Popovich says will be aimed largely at minicomputer based systems.

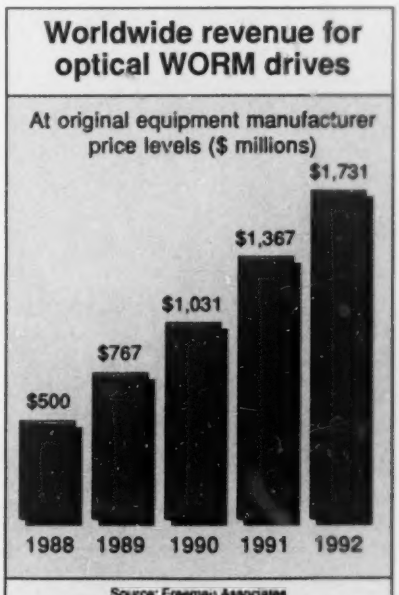
The larger 12-inch and 14-inch drives are aimed exclusively at high-powered systems for managing massive archives of documents and images. For example, Wang Laboratories, the Lowell, Mass., minicomputer maker, introduced a large-scale electronic image filing system last October. It includes digital document scanners and an optical WORM drive jukebox that can store 3.5 million pages of words and images. "As optical disc technology moves forward, it is the obvious direction to take in imaging systems," says Larry Mononen, senior product manager for the new line of equipment. Targeting the federal government and the banking, finance and insurance industries, Wang projects sales of $100 million in the system's first year. For four years, FileNet Corp. in Costa Mesa, Calif., has been selling similar systems, which produced revenue of $52 million for the company in 1987.

The next major use for high-end drives promises to be storage and management of computer data, making microfiche records obsolete in most instances, predicts Phil Shires, vice president for marketing and sales for LMSI, which makes drives for both Wang and FileNet. This helps explain why two photographic heavyweights, Eastman Kodak Co. of Rochester, N.Y., and Bell & Howell Co. of Chicago, recently introduced their own high-end WORM drives.

Optical drives must still overcome several obstacles before success is assured, cautions Robert Katzive, vice president of Disk/Trend Inc., a Los Altos, Calif., market researcher. WORM drives still lack standards, making it impossible to interchange units from different makers. They require complex software and electronics support to become part of larger systems. And they are expensive compared to older alternatives such as microfiche and possible new ones such as digital audio tape. "Optical drives haven't yet lived up to their promise," says Katzive.

SARAH GLAZER

Worldwide revenue for optical WORM drives



COMPONENTS

The connector consensus: Growth, but more shakeout

Connector makers see a double-digit uptick this year. The big question is whether a downturn hits next year — or late in '88

By Bruce C.P. Rayner

Last year saw some major tremors shake up the overcrowded connector industry as companies both big and small bought and sold divisions and restructured operations. Pundits agree the shakeout will continue as aftershocks reverberate through the market in 1988 and beyond. While the market looks healthy right now, many industry watchers expect it to turn sour by year's end.

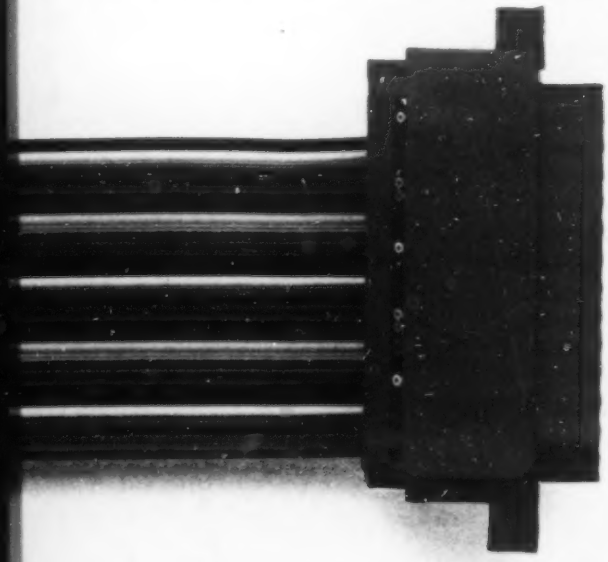
The consolidation trend is all part of the process by which a saturated middle-aged industry preps itself for the new globalization game of the 1990s. Entering niche markets in order to broaden product lines, cutting cost by streamlining operations and offering just-in-time capabilities to quality-conscious customers are all necessary changes taking place in the connector industry.

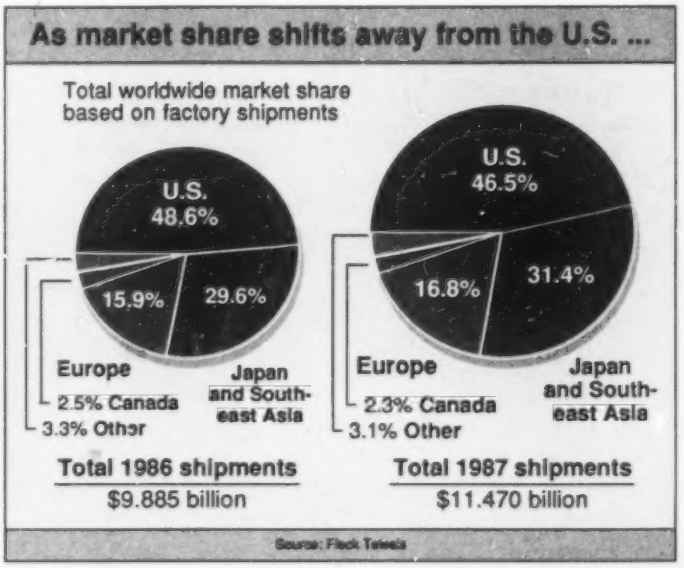
"What we saw in 1987 is a harbinger of things to come," insists James Marley, president of top-ranked AMP Inc., referring to the acquisition binge. "I have a sense that there will be a shakeout in the years ahead that will afford us opportunity for growth." Most of AMP's chief competitors agree that the consolidation means the strong will get stronger and the weak will disappear.

The long-term view is that there are still too many players vying for a piece of the connector pie. Analysts and competitors agree that the more than 600 companies currently in the business could easily be cut in half over the next few years with no detrimental effects to industry capacity. Estimates of 100 companies by the mid-1990s are not uncommon.

Given expectations of a modest 5% to 6% average annual growth rate for the industry for the next five years, coupled with a probable recession either later this year or next year, an acceleration of this paring-down process is likely. All told, last year saw 22 acquisitions and mergers; 11 joint ventures or licensing agreements; and restructurings at eight major corporations, reports Kenneth Fleck, president of the connector market research firm, Fleck Telesis Inc., of Huntington Beach, Calif.

Because of the overcapacity and overpopulation in the market, prices will continue to drop, says Fleck, an average of 2.5% a year over the next four years. Price erosion between 1980 and 1987 averaged 2.9%, Fleck estimates. But in the short-term, price





Top U.S. connector and interconnect suppliers

Source: Merrill Lynch Capital Markets Group

increases are not unheard of. For instance, Don Eisenberg, vice president for sales and marketing at Burndy Corp., says his company posted across-the-board price increases in January and he expects them to stick through 1988.

Whether prices can be sustained depends on the imminence of a recession. The consensus from Wall Street is not positive for the connector market, even though the current picture of the industry looks robust. Says Stephen Balog, a vice president for investment brokerage Shearson Lehman Hutton: "The incoming order picture [from connector makers] and what you are hearing back from the companies is very positive, but no one seems to be very excited . . ."

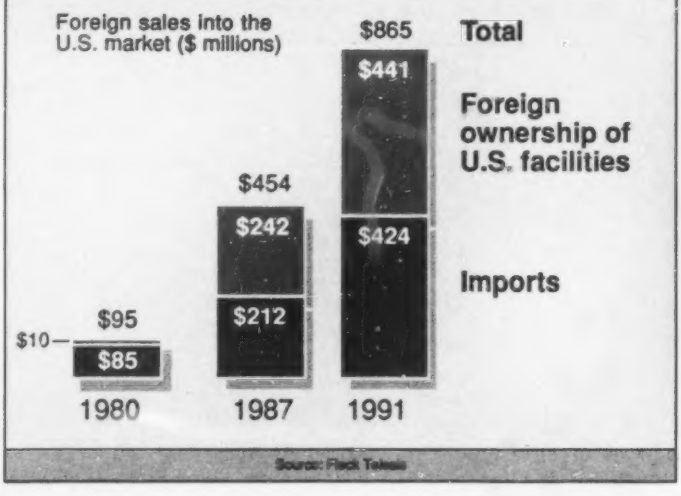
Recession? What recession?

"We are still looking favorably on the year," says Molex Inc.'s chairman, John Krehbiel Sr., "even though we are hearing a lot of noise from the media about a recession." He claims there is nothing on the horizon to indicate a recession anytime soon as both backlogs and customers' reactions are positive. AMP's vice chairman Harold McInnes concurs: "As we look to 1988, we see essentially a continuation of growth in the domestic marketplace of between 12% and 15%."

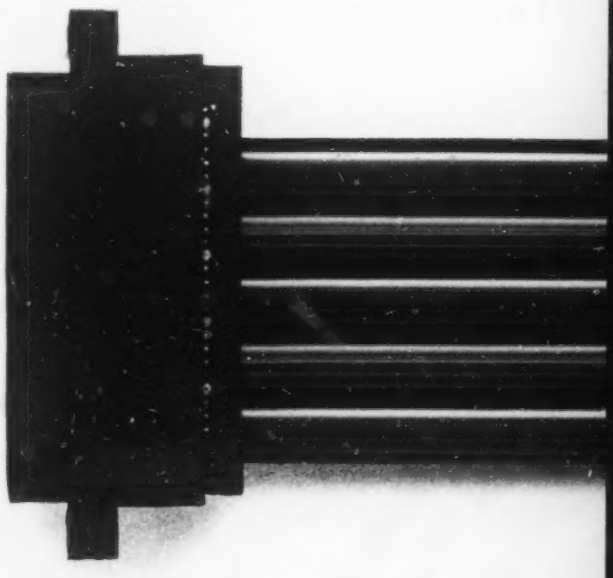
Dominic Pileggi, vice president for marketing in the electronics division of 10th-ranked Thomas & Betts Corp., sees the market as healthy and expects slow but steady growth on the order of 8% to 10% for the year. Eisenberg of Burndy agrees with that range, while E.I. du Pont de Nemours & Co.'s director of the interconnect and packaging group, Michael Emery, expects to grow his connector business between 10% and 15% for the year.

The book-to-bill ratio for most products in the connector industry is

... foreign competition is creeping in



Source: Flack Telesis



Martin Cooke

above parity, customers' and distributors' shelves are not overstocked, backlogs are stretching out and shipments are up, comments Charles Sloane, president of Sloane-Stewart Inc., a San Mateo, Calif., market researcher. But despite the bright picture, Sloane is forecasting the total worldwide merchant connector market to contract by 5.4% to $7.38 billion in 1988, from $7.8 billion in 1987, with most of that contraction caused by the market starting to head south in the third quarter of 1988.

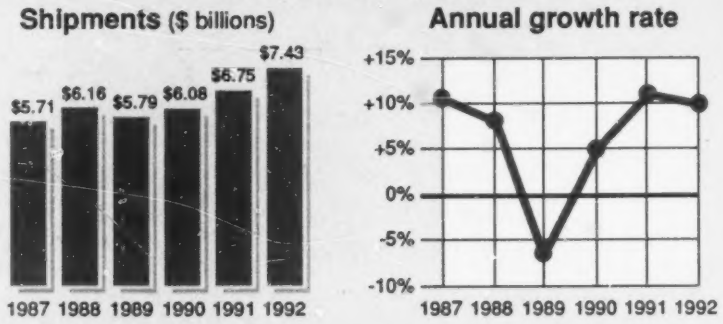
Fleck, on the other hand, sees the connector industry holding its own into 1989 even if the economy turns sour in 1988. Part of the reason is the nine-month lag in the commercial market and the 18-month lag in the military market between a general economic cutback and the time it hits the connector industry, says Fleck. Balog adds some wry optimism of his own: "The most positive thing you can say is that if we are going into a slowdown, at least we won't have to correct for the huge inventory overhangs like we did in 1984."

Adding to the uncertainty for connector vendors were numerous franchise changes and reshufflings within the industrial distribution community. Distribution accounts for around 26% of all connector factory shipments, says Fleck, and is likely to grow to 30% over the next five years. Even AMP, a slow starter out of the blocks, has grown its distribution sales from $30 million in 1981 to about $100 million last year, and sees potential for future growth through distribution. AMP estimates that distribution has a total available connector market of around $1.6 billion.

Leon Machiz, vice chairman of No. 1 distributor Avnet Inc., the parent of both Hamilton/Avnet and Time Electronics, believes both commercial and military connector business is healthy at this point. "The market looks very strong and every indication is that it will continue," he says.

Expect a downturn in shipments next year

Forecast of U.S. connector factory shipments

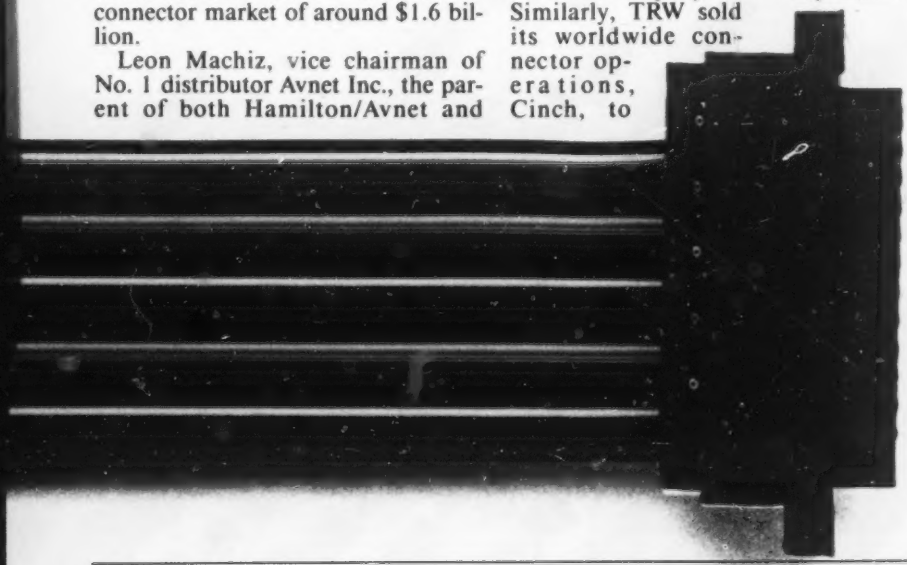


Shipments include connectors, cable assemblies, backplanes, contacts, telephone jack fields, terminal junctions/modules, packaging panels, flexible circuit jumpers and custom-use tools

Source: Fleck Telesis, ELECTRONIC BUSINESS

Divestitures

Nevertheless, connector industry consolidation rolls on. Two of the biggest sales in 1987 involved total divestitures of connector operations by defense industry leviathans Allied-Signal Inc. and TRW Inc. In May, Allied-Signal sold its Amphenol Products Group, a total of 22 facilities worldwide, to LPL Investment Group Inc., a Wallingford, Connecticut-based public investment company, for $430 million. LPL has since sold segments of Amphenol in order to make the company more competitive. Similarly, TRW sold its worldwide connector operations, Cinch, to Precision Mechanique Labinal, a French company, for about $130 million.

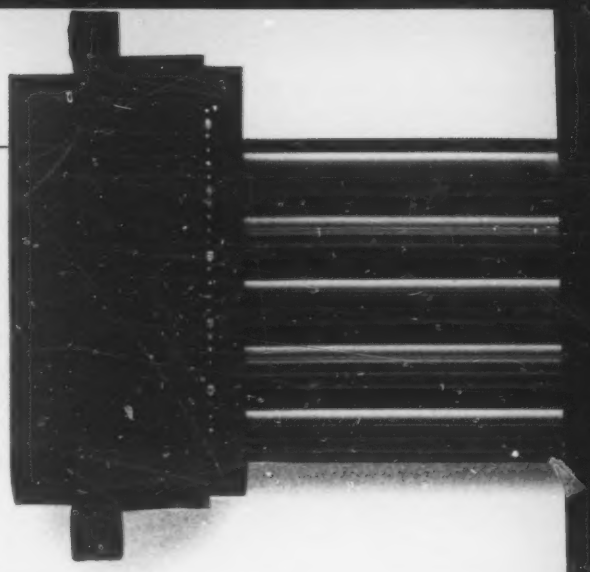


For the industry, the bottom line of such sales is positive, says Jerry Labowitz, a vice president with Merrill Lynch Capital Markets in New York City. Buyers like LPL are streamlining, consolidating, and taking old facilities off line. That means less capacity, higher efficiency and lower costs. "Longer term, this should bode well for the industry, because these buyers are profit-oriented," says Labowitz.

While TRW and Allied-Signal exited the business in 1987, other conglomerates renewed their commitment to the connector industry. 3M Co., often criticized for having too narrow a product offering, entered the fiber optics market in 1987 in a big way with the acquisition of Dorran Photonics Inc. in January and EOTec Corp. in June. Similarly, last year, Augat Inc. integrated Elfab, a backplane supplier, into its operations and purchased Compagnie Teletechnique Moderne SA, a French supplier of modular connectors, to round out its European presence.

As for what's hot in 1988, the big buy is expected to be military connector maker Matrix Science Inc. The Torrance, Calif., company is reported to be actively seeking a buyer. At press time, AMP has close to a 13% interest in the company, but is facing competition from market rival Molex Corp., the fourth-ranked player, with a 6% interest. Most industry watchers expect AMP to win out.

Another factor in the competitive equation is the threat from offshore.



Foreign competition, although dampened by the U.S. dollar devaluation, is intensifying. Japanese connector makers are intent on increasing their market share in the United States by selling through distribution and by focusing on niche markets in custom connectors. Fleck forecasts that foreign sales into the United States will increase from 9.7% of current market share to 14.3% by 1991. Joel Urban, marketing manager at Fujitsu Components of America Inc., in Santa Clara, Calif., says Fujitsu is one Japanese connector maker that has a formal policy for increasing its U.S. presence.

Passing the buck

Surface mount applications have been slow to materialize and fiber optics is still in the realm of long-distance telecommunications, but both are destined to catch on in a big way. For connector makers, surface mount capabilities mean an investment on the order of $10 million, part of the reason for the slow pickup and a factor that is not looked upon kindly by the smaller connector shops. Also, as computer makers pass more responsibility for surface mount boards upstream, they will expect suppliers to offer more than just individual connectors. They will want the entire board assembly, connectors and all. "As that occurs sometime in the next 10 years, it means that connector houses will have to be more involved in the subassembly and the whole packaging of the board with connectors already mounted," says Fleck.

Du Pont's Emery believes that day is already here. "Our customers don't want to buy just connectors," he says. "They want to buy more forward integrated products and they want a supplier that can provide the engineering and then get it all made and put together with the right timing, the right quality and the right cost," Emery claims. "They," in Du Pont's case, are: Apple Computer Inc.; Digital Equipment Corp.; Hewlett-Packard Co.; and IBM, to name a few.

On the fiber optics front, market acceptance in short-link local area networks and inside computers is still around the corner. The market for fiber-optic connectors grew to about $60 million last year, up from $25 million in 1984, largely as a result of long-distance telecommunications business. But now that this segment has reached saturation, vendors like AMP, 3M and Du Pont are waiting for the LAN market to catch on. Fleck predicts 20% annual growth in this market segment over the next four years.

However, very few fiber-optic connector makers are believed to be profitable, analysts agree. Most of the losses are put down to R&D expenses. No surprise, then, that the parent of No. 2-ranked Amphenol, LPL, has been actively seeking a buyer for its fiber optics operation since the middle of last year. □

JIT helps connector users trim those supplier lists

JIT — having a component arrive on the factory floor exactly when it is needed — first gained preeminence in Japan last decade and has now permeated the U.S. and European electronics industries. Most industry watchers agree its effect on the connector industry will be profound.

Customers and vendors alike are maintaining closer control of work-in-process inventory, and programs like statistical process control (SPC) are being implemented on a corporate-wide basis. With dock-to-stock programs gaining popularity among the big computer customers, total quality of components has taken center stage. "The connector market is very different from 1984 because today you have JIT," says Jerry Labowitz, a vice president with Merrill Lynch Capital Markets in New York and a long-time follower of the industry.

"JIT and quality are prerequisites: you have to have them just to play the game," says Michael Emery, director of E.I. du Pont de Nemours & Co.'s interconnect and packaging group. And with the advent of a standard electronic data interchange in the next decade, says Ken Luczaj, vice president for sales and marketing at Litton Industries Inc. Winchester Electronics Division, just-in-time sourcing will take on a whole new meaning for the entire electronics industry, connectors included.

The bottom line in this revolution is that the number of connector vendors that big customers will deal with is declining. It is increasingly common for partnerships to be formed between the customer and a few key suppliers offering a broad range of products.

"Finding a supplier that can provide the right product on time means that many of our customers are having to reduce their supplier lists," claims James Marley, president of market leader AMP Inc.

Unisys Corp. is purging the ranks of its connector suppliers and expects to drop 10 of its 35 vendors in the next few years, says Robert Belzman, manager of procurement and contracts in the component engineering and procurement organization of Unisys, in San Diego. Unisys wants to work with suppliers that maintain close control over their manufacturing processes: that includes SPC programs and parts-per-million calculations of failure rates. Currently, says Belzman, Unisys is looking for a few suppliers to certify for a dock-to-stock program.

Unisys is not alone in its policy. Hewlett-Packard Co. has its own reduced vendor program. Over the past few years, HP has cut its corporate-wide connector vendor agreements from 40 to 25, says Ivan Garrison, commodity manager for interconnect systems at corporate headquarters in Palo Alto, Calif. □

SURFACE MOUNT TECHNOLOGY

These are glory days for SMT production gear firms

They're finally seeing backlogs swell as America embraces SMT. The users' main problem is what to buy, and from whom

By Michael R. Leibowitz

About the time that technicians installed the last piece of equipment on Manufacturing Services Inc.'s first surface mount technology (SMT) production line, Benny Lee, owner of the small, 67-employee contract manufacturing house, went into his office, picked up his telephone and called his vendors with an order for a second line. "I need to support my customers," says Lee, adding that already, his first SMT customer wants 100% of his capacity. With other customers clamoring for SMT production capability, Lee says that he needs more capacity immediately.

These are the glory days for makers of SMT production equipment, who are seeing their order logs swell as the United States finally turns on to SMT. For five years, SMT has been the manufacturing technology of major Japanese and European electronic equipment makers. Within the past two years, however, large, medium and small U.S. producers of electronic equipment have begun to embrace SMT as the standard technology for producing world-class electronic products.

With estimates saying that as much as 75% of Japanese electronic equipment production is now using SMT, and with the popularity of a new breed of high pincount ASIC chips requiring SMT, U.S. makers are finding they have little choice but to bear the high equipment costs, and climb onto the SMT learning curve. Equipment makers are turning the prototype lines they built to learn SMT into full-scale production facilities, while SMT veterans are bringing up additional lines to convert more of their production to SMT. Meanwhile, the novices are enlisting contract manufacturers to help them into the SMT world.

Pamela J. Gordon of Technology Forecasters Inc., a Berkeley, Calif., market researcher, says that last year, the value of printed circuit board (PCB) assemblies utilizing SMT grew a whopping 44%. This compares dramatically with through-hole growth, she says, which barely eked out a 6% growth. It puts the SMT portion of all PCB assemblies, by value, at 12% in 1987, a rise from 9% the previous year.

Royal flush

Accordingly, SMT production equipment makers find themselves flush with orders. They report particularly strong demand in the United States and the Pacific Rim, with Europe also contributing good growth. Universal Instruments Corp., for example, reports an 80% increase in SMT business during 1987. Fuji America Corp.'s general manager, Iwao Yamaguchi, calls 1987 sales of his company's SMT production gear "quite brisk."

By most estimates, 1988 is shaping up to be another great year. Universal's James Roth, vice president for marketing and sales, expects his SMT business to double in 1988. Fuji America's Yamaguchi, based in Elk Grove Village, Ill., sees 1988 as a "straight extension of 1987."

Charles-Henri Mangin of Ceeris International, an Old Lyme, Conn., market consultant, says that the first half of 1988 will be "very good," with a possible slowdown, reflecting last October's stock market crash, occurring in the second half. And Technology Forecasters predicts that U.S. sales of SMT production equipment

UNIVERSAL INSTRUMENTS' ROTH: Expecting his SMT business to double in 1988

will grow 34% in 1988 to $377 million, from $282 million in 1987. The SMT portion of all circuit board assemblies will top 15% in 1988.

The infant production equipment industry is in a phase in which each year brings a wealth of new and innovative items. The 1987-88 edition of the *Surface Mounting Directory*, published by Info-Mation Inc. of Warrington, Pa., lists 1,155 items of SMT production and test equipment from 239 manufacturers. This is up 22% from 947 equipment items in the 1986 edition.

Vendors typically fall into one of three categories: Japanese and European broad-range suppliers of high-volume production equipment, such as Fuji Machine Manufacturing Company Ltd., Panasonic Industrial Co., N.V. Philips GL, and TDK Corp.; American broad-range producers of high-flexibility production equipment, such as the Dynapert division of Emhart Corp. in Beverly, Mass., and Universal Instruments Corp. in Binghamton, N.Y.; and specialized producers of medium- and low-volume equipment of a particular type, such as Excellon Automation, a division of Excellon Industries, in Torrance, Calif., Quad Systems Corp. in Horsham, Pa., and Vitronics Corp. in Newmarket, N.H.

While customers are clearly benefiting from the explosion in new products dished up by these vendors, it has imposed big challenges on them. Vendor and equipment selection is "a difficult, long, drawn-out, expensive process," says Info-Mation's president, Donald Brown, who adds that the process can take as long as a year.

Customers report that nowhere other than in the process of selecting SMT gear is it as important to figure out precise requirements, such as volumes, board mix, types of components to be handled and degree of automation required.

Kicking the tires

For evaluating speed, an increasing number of SMT equipment customers are ignoring vendor claims and are instead, asking vendors to run an actual board through their pick-and-place machines. Placement speeds vary considerably depending on the particular board being run, and actual placement speed — a critical decision criterion — rarely comes close to vendor specifications. James Elliott, director of advanced manufacturing at computer peripherals maker Western Digital Corp. in Irvine, Calif., recommends asking vendors to set up their machine for an actual board and says most vendors will comply.

Contract manufacturers will be buying more SMT production gear, too

Source: Technology Forecasters

Reliability is more difficult to measure, and SMT equipment users say that the only way to evaluate this is to talk to other users. One user visited local references supplied by his equipment manufacturers while Robert Rowland, manager of disk drive maker Iomega Corp.'s printed circuit assembly engineering group in Ogden, Utah, talked to current users and relied on his previous experience with Universal equipment as a guide. Western Digital's Elliott traveled to Japan to visit the factory and talked to Sanyo Electric Company Ltd. users there. "They were building the same machine for 10 years," Elliott says. "I talked to some and found that they were very happy and had purchased more through the years."

One of the biggest areas of controversy facing customers today — and one receiving much attention by vendors — is the question of buying a line from multiple vendors versus buying the ensemble from a single, broad-range vendor. Besides offering compatibility for connecting machines together into an automated, integrated system, buying from a single vendor has the advantage of one-stop service with no finger-pointing between vendors.

On the other hand, with the explosion in new, innovative products, some customers prefer to pick and choose. Cincinnati Microwave Inc. built its integrated, automated line with equipment from several manufacturers. "We felt like we would get as good a capability for less money," says Jon Prokop, engineering manager of the company's advanced manufacturing group. "And, there was some possibility that we would be able to meet our requirements better," he adds. "Everybody I've talked to with a completely turnkey job has always gotten one item they [com-

The accuracy urge

Other big changes in the SMT equipment market include the move to more accurate pick-and-place machines, for handling the new generation of high lead-count ICs with lead spacings of 0.025-inch and less. Many IC pick-and-place machines that are now shipped utilize vision systems, according to Maurice Sage, managing director of BPA Ltd., an SMT researcher and consultant in Cold Spring Harbor, N.Y. Vision systems examine the orientation of the component and the board and instruct the placement head to make corrections where necessary.

Sage says that vendors have more work to do in the area of accuracy. "Placement accuracy is limiting the yield," he says, adding that typical misplacement rates of 100 parts per million are unsuitable for high-volume, high-value customers who must slow down their machines in order to get suitable yields. But market consultant Ceeris International's Charles-Henri Mangin, says accuracy is no longer a problem, and that it was not a simple task for pick-and-place makers to improve their machines from 10,000 parts per million, the misplacement rate of 1983, to 100 parts per million. "But it's going to be a lot more expensive" to go to 10 parts per million, he says.

Leading pick-and-place machine makers, according to Mangin, include: U.S. makers Dynapert, Excellon Industries, Quad Systems Corp. and Universal Instruments Corp.; and Japanese makers Fuji, Panasonic Industrial Co. and TDK Corp. N.V. Philips GL is another pick-and-place leader. □

JAMES MITCHELL OF QUAD SYSTEMS: "About half of the equipment we are asked to quote on is to the SMEMA standard"

plain] about a year later."

The trend toward automation — tying machines together to eliminate manual transfer of boards — is a major factor fueling the single- versus multiple vendor controversy. SMT production equipment makers report that more and more customers are opting for the integrated approach to reduce labor costs and improve quality. According to Universal's Roth, 55% to 60% of the company's SMT business was in systems in 1987, up from 25% in 1986. In 1988, he predicts, it will approach 80%.

And in the move toward automation, broad-range equipment manufacturers have the natural advantage. Their machines bolt together and have provisions for communicating among each other and with a central controller. Since broad-range vendors offer most pieces of the line, they can sell customers integrated, turnkey systems using their own equipment, filling in the holes with third-party gear where necessary.

Plight of the specialists

The broad-range vendor's ability to ship turnkey systems contrasts with the plight of specialty vendors who often manufacture and sell only one portion of the line and do not have the other pieces to integrate. In fact, until recently, customers could not do this integration themselves: the equipment of one vendor would not mate with the equipment of another.

Within the past year and a half, however, specialty vendors of single machine types have gotten some help from the standardizing activities of the Surface Mount Equipment Manufacturers Association (SMEMA), which has developed and published standards for mechanical and electrical interfaces of individual machines. Many specialty vendors are already producing equipment to the SMEMA standard and there are indications that customers are embracing the standard. James Mitchell, president of pick-and-place machine maker Quad Systems and past president of the SMEMA, says that currently "about half of the equipment we are asked to quote on is to the SMEMA standard."

But, while specialty vendors standardize, broad-range suppliers are filling in the holes in their product lines to provide more of an integrated "solution" to customers. TDK uses third-party equipment to fill in the gaps in its line, according to TDK Corp. of America's Asahi Yoshitomi, based in Skokie, Ill. He expects a full 60% of his business to be integrated systems in 1988, whereas in 1987, he was mostly selling single machines. Dynapert, to lure more systems business, recently introduced an infrared (IR) reflow machine and a computerized line control and reporting system, points out Walter Rizzi, a Dynapert vice president.

Broad-range vendors currently have and will probably keep their hefty advantage with high-volume customers, say analysts. But the question of which way the medium-volume and small-volume customers will sway is still open. In the medium-volume range, Cincinnati Microwave, for example, preferred to integrate its multivendor line itself. But Iomega, which also installed a fully automated line, only looked at broad-range vendors "that can supply a line from A to Z," according to Rowland.

Smaller volume customers, on the other hand, are more cost sensitive when buying equipment and less likely to be concerned about integration. Analysts expect the newer, specialized vendors to do particularly

SMT boards go for that all-over tan

In the area of SMT soldering systems, the overwhelming trend is toward infrared (IR) reflow, which utilizes IR heating elements to create a multizone oven for heating the solder paste on the circuit board. IR reflow is cleaner, less expensive and potentially less damaging to components than vapor phase reflow, the previous standard, which passes a hot Freon-based vapor over the board. And with improvements to IR reflow equipment, previous obstacles to IR's growth, such as the problem of uneven heating, have been removed. According to Howard Miller, Universal Instruments Corp.'s SMT marketing manager, most customers are now choosing IR, a "dramatic switch over," from two years ago.

Vapor phase still has uses, primarily for military applications, which are denser and require much more energy to heat the board uniformly, according to James Blankenhorn, president of SMT Plus Inc., a San Jose consulting firm.

According to Charles-Henri Mangin of Ceeris International, a market consultant, Vitronics Corp., an IR pioneer, is No. 1 in market share in reflow systems. Vitronics is followed by other vendors such as Dynapert, Radiant Technology Corp., of Cerritos, Calif., and the broad-range SMT makers. □

Gene Mopsik

well in this segment. The medium-volume segment, meanwhile, will probably be the main battleground for specialized and broad-range vendors.

American broad-range SMT vendors are bracing for another contest, this time with the Japanese. Japanese companies have developed a stronghold in the high-volume segment of the market, where expertise in producing consumer products has given them a rich selection of high-speed products and a spotless reputation for reliability. "They have five to 10 years more experience than we do" in building high-volume SMT lines, says Mangin.

While the Japanese mainly developed their SMT production expertise in house, American SMT vendors built their product lines by concentrating on the typical types of companies found in the United States: medium- and low-volume electronic equipment makers, who, rather than being concerned about speed, are more interested in flexibility, or the line's ability to allow quick reconfigurations and to handle a wide range of components.

But as key U.S., European and Pacific Rim customers finally take SMT into high-volume production, Universal and Dynapert, the major U.S. broad-range vendors, have become concerned about losing this high-end business and are expanding their offerings into the high end.

Chip shooters

The main weapon is the pick-and-place machine, which often accounts for half of the cost of an SMT production line and is regarded by many as the most critical item in determining the line's throughput and flexibility. Japanese high-speed "chip-shooters," for example, plunk down resistors and capacitors in excess of 10,000 components per hour. The fastest machines from Universal and Dynapert, in contrast, had ratings of 4,500 to 6,000 components per hour.

Within the last year, however, both Universal and Dynapert have introduced new high-end pick-and-place machines that they rate at 12,000 to 14,000 placements per hour. And more new high-end products are on the way.

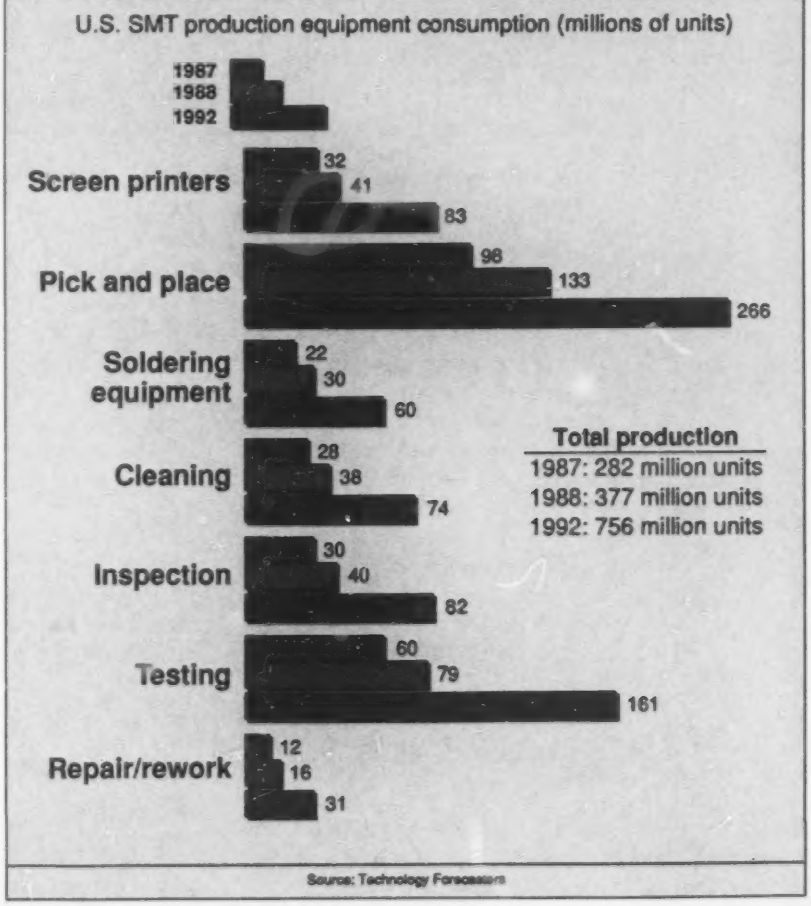
Meanwhile, Japanese companies are trespassing into the sacred territory of Universal and Dynapert: high product mix and high-flexibility accounts. The pick-and-place machine is, again, the key item. Many Japanese pick-and-place machines accomodate a limited range and number of component inputs and are time-consuming to reconfigure. American machines, in contrast, allow more inventory to be placed on the machine at one time and are more easily reconfigured to accommodate different boards.

Both Universal and Dynapert have introduced high-end pick-and-place machines that they rate at up to 14,000 component placements per hour

Prospects for the Japanese to make a successful crossing into high-mix, medium volume and lower volume accounts are still uncertain. Japanese companies such as Fuji will be introducing new, flexible machines to the U.S. market in 1988, according to Fuji America's Yamaguchi. Universal's Roth admits concern about the Japanese, but is confident about the strength of his company's technology and customer partnerships.

Likewise, no one can say if U.S. production equipment makers will succeed in grabbing a large share of the high-volume market. Consultant Mangin does not think so. "I think the Japanese have more experience," he says. However, Roth believes that flexibility may win the contest for high-volume accounts. The Universal executive notes that the needs of small-, medium- and large-volume customers are "melding together. Even people who produce high volumes want to produce it in a just-in-time fashion. They want to run only those particular items ordered that day." □

Here's why SMT production equipment makers are flush with orders



Source: Technology Forecasters

COMMUNICATIONS

Motorola and NEC gear up for car phone clash in Europe

Their joint domination of Europe's cellular phone market could end with a 1991 debut of standards for digital cellular networks

By Jack Gee

Man the defenses, Motorola! To your battle stations, NEC! Your commanding positions in Europe's mobile communications market are under attack. European manufacturers are preparing to storm a citadel which, until now, has been dominated by the United States and Japanese giants. They intend to capture a booming business for car phones, portables, pagers and private radio systems.

This challenge is a top priority for the U.S. and Japanese manufacturers. They do not intend to be caught unprepared in 1991, when 13 European countries introduce cellular radio standards that enable the same equipment to be used from one end of the continent to the other. But they will have to contend with a more belligerent type of European competition than before.

"The introduction of pan-European standards could offer new opportunities to outsiders," says Edward M.A. Mier, director of the European Telecommunications and Computer Division at Dataquest Inc. "With only one set of standards to cope with, NEC Corp. could flood Europe with low-priced cellular handsets," Mier adds.

Until now, the use of analog technology has hampered cellular radio's development. Equipment in use varies from one country to another. When a motorist drives only half a mile from France over the river Rhine, his car phone will sink into sulky silence on the German side. As travelers cross Europe's borders, except those within Scandinavia, they suddenly find they can make calls only if they use locally-made phones.

All that will change with the introduction of a pan-European digital cellular network. Within three years, customers will be able to use their cellular phones throughout most of Europe. The United States is likely to have 2.6 million cellular telephones in use by 1990. Europe, which currently musters about 500,000 users, is expected to field 3.3 million in 10 years, according to Communications and Information Technology (CIT) Research, a British communications company.

ALCATEL'S PIERRE SUARD: plans to make his consortium a major actor in Europe

With 310,000 subscribers, Scandinavia's Nordic Mobile Telephone (NMT) network, for which Sweden's L.M. Ericsson and Finland's Nokia both supply systems and telephones, groups the biggest number of users in the world. Nokia's electronics division, Mobira, has already driven its way into the U.S. market with mobile phones that are made in South Korea under a joint venture with Tandy Corp. and distributed through Radio Shack stores.

Britain now has 150,000 subscribers for a much larger population than Sweden, which it recently overtook to become the biggest European market for cell phones. Britain is also the only country in Europe with two competing networks, Cellnet and Vodafone. Dataquest's Mier explains: "By deregulating its telecommunications industry, Britain has given itself a head start in the cellular business."

Without foreign equipment, the British market for mobile telephone equipment could never have grown at its present fast rate. Virtually all the basic technology for setting up cellular coverage has come from Ericsson, supplier of the Racal Vodafone network, and Motorola Inc., which has established the rival Cellnet system. Investment of around $360 million has probably been shared equally by these two suppliers.

France, with only 30,000 radio phone subscribers, still lacks a fully cellular service. But, under a strategy to slowly deregulate some sectors of its telecommunications environment, the government has opened up the market for the radio and car phone. Early last year, Telecommunications Minister Gerard Longuet gave the go-ahead to the state-controlled telecom authority — recently renamed France Telecom — to team up with Matra, the defense and electronics group, in the cellular phone business. In December, a rival

consortium was allowed to compete. Headed by Compagnie Générale des Eaux, a large private water distribution group, it includes Alcatel, the French-controlled telecom concern, and Finland's Nokia.

The French announcement followed a rash of other European alliances in radio phone design, manufacturing and marketing in readiness for the horizon of 1991. Before joining Compagnie Générale des Eaux, Alcatel had already teamed up with AEG AG of West Germany and Nokia in another consortium. Philippe Glotin, managing director of Alcatel's radio and telephone division, says: "Together, we shall spend about $100 million on research and development. We have to start now. When the market is fully opened, the competition is going to be very intense indeed." Pierre Suard, chairman of Alcatel, comments: "Our three firms could make this consortium one of the major actors to address the mobile phone market."

In Britain, Racal Electronics Plc, which owns the Vodafone cellular network, has joined The Plessey Company Plc to create a new company, Orbitel Mobile Communications. Ericsson has also signed on with Orbitel, which is considering whether to adapt System X, the digital central office switch developed by Plessey and Britain's General Electric Co., for the cellular market. Cellnet, the competing British cellular network owned by British Telecom and Securicor, a British armored-car security company, is talking to European telephone operators about exchanging stakes in each other's networks.

In another alliance, Philips Kommunikations Industrie AG, a German subsidiary of the Netherlands-based group, and two German concerns, Robert Bosch GmbH with its offshoot Ant Nachrichtentechnik GmbH, have agreed to develop their own cellular technology in readiness for Europe's 1991 deadline.

Until a year ago, Germans waiting to put a mobile phone in their Mercedes were unlucky compared with Britons making the same plans for their Bentleys or Scandinavians for their Volvos. "But now we are gearing up to meet requirements," says Josef Kedaj, director of Public Mobile Communications at the Bundespost, the state-controlled telecom and postal body. West Germany's Siemens and Sweden's Ericsson are working together on a new generation of mobile phones which they claim will tie Scandinavia and western Europe into a seamless communications system. But meanwhile, with only 52,000 users, Germany has the smallest network in Europe.

So far, U.S. and Japanese suppliers are absent from these alliances. "We Europeans have to be careful," a senior executive of one of Europe's biggest electronics groups says. "If we let Motorola or NEC in, they will gobble us up alive."

In contrast, all the European cellular groups are keen to have Ericsson as a partner. Dataquest's Mier says: "The pan-European cellular standards will be based on those of Scandinavia's NMT network, for which Ericsson has provided the basic technology. So it's natural for everybody to be courting the Swedish firm."

While Dataquest estimates the 1990 value of the U.S. cellular market at almost $5 billion, spending on equipment and services in Europe will reach $4 billion, according to CIT, the British research organization. Europe has lost precious time in establishing standard processes for its continent-wide network.

Value-added services are a key marketing gambit in all 13 European countries which are gearing up for the full scale arrival of the cellular phone. "More and more people need to transmit or receive data while they are on the move," says Peter Waller, managing director of Britain's Cellnet network. Maurice Remy, managing director of France's Matra Communication, remarks: "Value-added services are going to be a major market. All business users of mobile phones will soon have a need for them." □

European cellular phone market

Source: Communications and Information Technology Research

Motorola won't be left out

Motorola Inc. is determined not to miss the big opportunity offered by Europe's 1991 deadline for the advent of a continent-wide cellular system. It is already staking out its claim.

Neck and neck with NEC, Motorola has captured more than one-quarter of sales in Britain's cut-throat market for handset equipment. But it is being challenged by Japan's National Panasonic in the up-market product range. Finland's Nokia Mobira and Canada's Novatel are also important suppliers.

Motorola and NEC Corp. owe their powerful positions in the handset market to their strength in semiconductor technology and the special emphasis which they have given to telecommunications devices. NEC, which has until now imported its equipment, plans to invest in a new plant in Telford, England. Motorola assembles handsets at Stotfold, England. It also employs about 100 people at its Basingstoke, England, network facility.

Don Burns, managing director of Motorola's Communications Division in Britain, says: "We are planning steady expansion. This could double the 500 people we have working on cellular products to 1,000 over the next four years." □

OPERATING SYSTEMS

Painting Unix blue: How IBM stoops to conquer

The Unix operating system is supposed to make users like GM and the U.S. government supplier-independent. IBM has other ideas

By David Card

Unix from IBM? The idea seems self-contradictory. The major benefit of the industry-standard but AT&T-owned Unix operating system is that it frees software from hardware dependence. That is, software written for Unix is easily moved between computers from different suppliers. Everybody knows that account control is the IBM way.

But there it is — IBM launching a serious Unix effort. Only it's not Unix, it's AIX, IBM's pet version. And that makes a whole Blue world of difference.

AIX, for Advanced Interactive Executive, was developed under the auspices of IBM's Austin, Texas, Advanced Engineering Systems (AES) business unit. That unit — which last summer moved under the control of the Entry Systems Division, home of IBM's personal computers — is also the birthplace of IBM's much-maligned technical workstation, the RT PC. In fact, AIX and the RT go hand in hand as each is optimized to enhance the performance of the other.

At a press conference in February, some IBM heavyweights, including J.L. "Jerry" Latta, the group director of Technology Computing Systems, and William Lowe, president of Entry Systems, pledged renewed support for AIX and "RT follow-ons." They said IBM is adding over 1,200 marketing representatives and systems engineers for the combo this year, and at least that many again in 1989. Lowe said that the money and people going into the pair equaled that which IBM is expending on its new personal computer line, the Personal System/2 series.

As yet, AIX has only tenuous ties to Systems Application Architecture, IBM's grand scheme to tie together its disparate hardware, software and operating systems. SAA is a long-term project to ensure that any software will run on any IBM hardware, and look the same to the user. If SAA sounds a little like Unix, it should. Their goals are similar, with the key exception being that SAA works only in the Blue domain.

And so far, AIX only runs on the RT and the high-end models of IBM's PS/2 family. But IBM has plans to eventually move the operating system up to its mainframes and downward to its entry-level PS/2s.

Despite that, many IBM competitors, analysts and third-party software developers remain skeptical about IBM's commitment to a standard operating system. Many think IBM is supporting Unix begrudgingly. "I think they've been dragged kicking and screaming into Unix," says E. Joseph Zemke, president of IBM mainframe rival, Amdahl Corp. "But IBM knows that it's not going away."

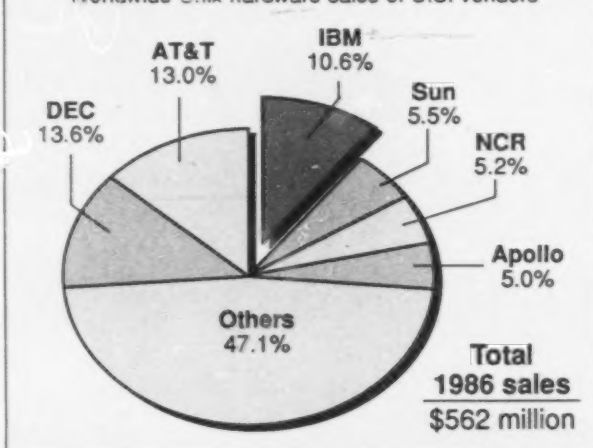
Unix certainly is not going away. Framingham, Massachusetts-based market researcher International Data Corp. forecasts that hardware running Unix will account for 22% of the computer dollars sold by U.S. vendors in 1991. That's up from only 6% in 1986, and means that Unix will rival the market shares of IBM's mainframe and PC operating systems.

The people working on AIX and the RT are at AES under vice president and general manager Andrew Heller. Heller, an IBM Fellow, is something of a maverick by Blue-suit standards. His favorite footware is a pair of cowboy boots made of lizard skin — "desert rat" in Austinese — and he's proud of the fact he wasn't fired for showing up at a management meeting on a motorcycle.

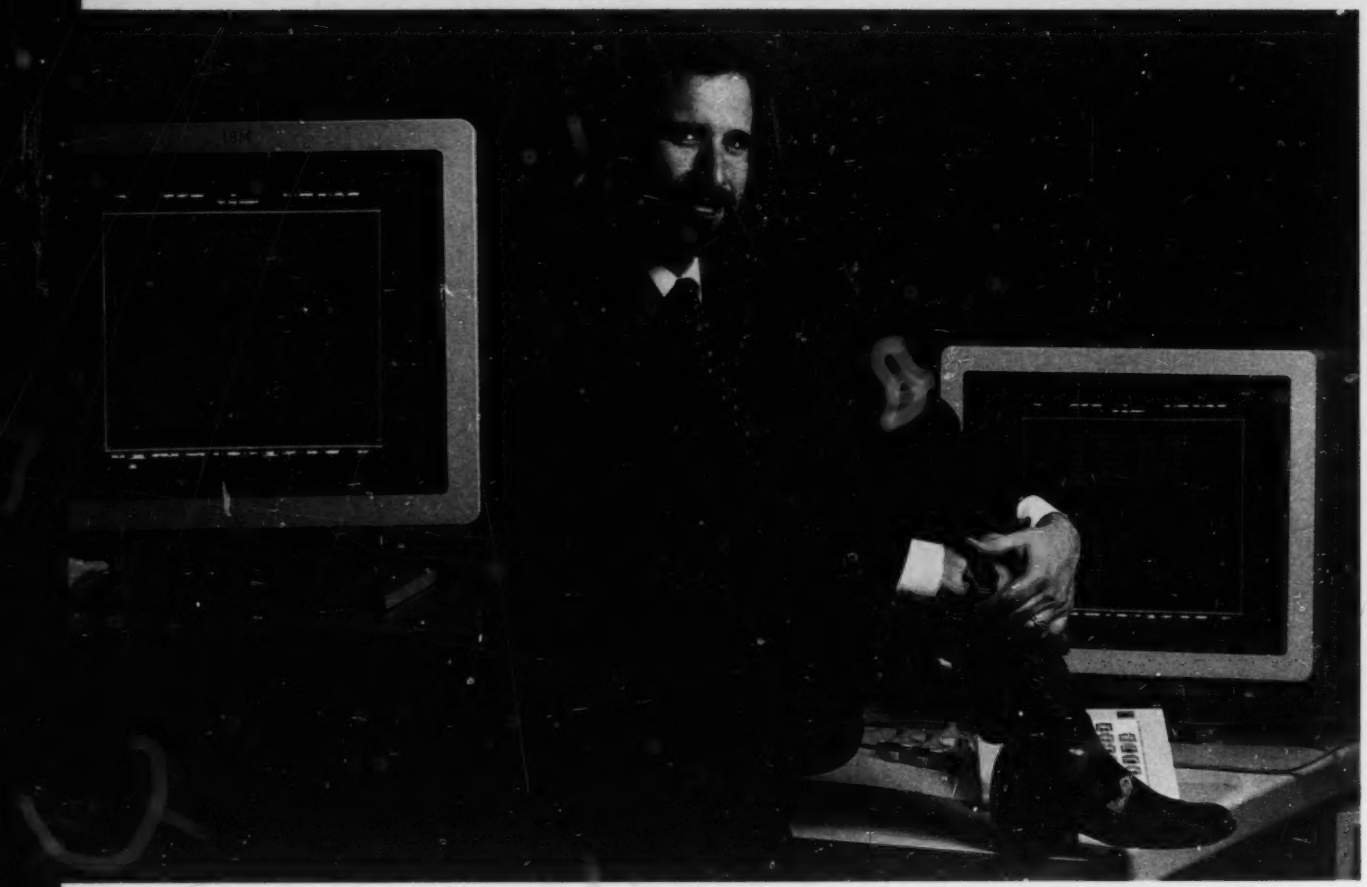
Heller won't say how big

IBM is already a leading Unix player

Worldwide Unix hardware sales of U.S. vendors



Source: International Data Corp.



IBM's ANDREW HELLER: "We're providing a Unix based on AIX that we think is the leading-edge system out there today"

the operation at Austin is, except that "it's a *big* division. I have a lot of people." Plus, programming chores are parceled out to other IBM divisions as well as to outside contractors like Interactive Systems Corp. and Locus Computing Corp., two Santa Monica, Calif., companies that have worked on AIX.

"The philosophy we have in Unix is quite simple," Heller says. "We just want to provide the widest range, from top to bottom, of price/performance offerings, the best operating system, and, we believe with our RISC follow-on products, the absolute best price/performance you can get anywhere in the industry. That ought to be enough to get people's attention."

Heller describes Unix's most influential feature: "Portability, an open system interface, is the strength in this. It's the strength that's allowing and driving the industry to be the most creative segment of the entire computer industry." Uncommon words from an IBM employee, even a maverick.

When it is pointed out that vendor independence and transportability fly in the face of traditional IBM marketing techniques, Heller forms this answer: "We're providing a Unix based on AIX that we think is the leading-edge system out there today. It ties to our SAA systems as no other Unix system does. It offers more capability than any other Unix. And it's an industrial-grade system. Given those three things, we believe we offer a value-added that no on else is going to offer.

If SAA sounds a little like Unix, it should. Their goals are similar, with one key exception — SAA works only in the Blue domain

"Now the fact is, a large number of applications are being generated by a large number of vendors who are going to go to Unix with or without us. If we provide the best Unix, they'll start with us. If we ignore them, they're going to keep on going in what is becoming a very interesting segment of the business."

The vendors developing those applications are not exactly lining up in Austin. In fact, in the area of computer-aided design and engineering (CAD/CAE), a stronghold of Unix software, they're walking away. The PC CAD leader, Autodesk Inc., built its business on the IBM PC, and now offers software for Unix workstations. But Autodesk quietly dropped a package that ran on the RT. Similarly, Valid Logic Systems Inc. crowed about its IBM efforts — until it teamed up with Digital Equipment Corp. and Sun Microsystems Inc.

Heller says IBM will work closely with "specific vendors," mentioning Dassault Systemes, the French company whose 3D CAD package IBM resells. "There will be some applications that the Advanced Systems Development Division, which is our new programming division, will either find for us or build for us," Heller says. "But in the Unix world, our intent really has been to find the best and try to work with it."

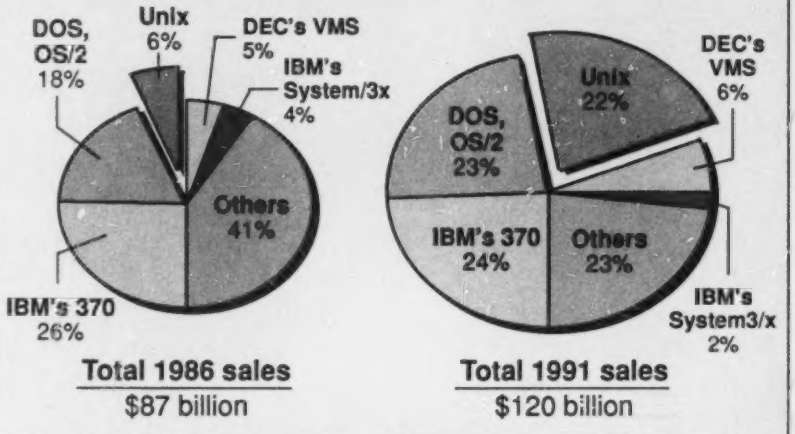
Private strategy?

Originally, IBM supplied Microsoft Corp.'s Unix, called Xenix, for its PCs. In 1985, IBM was the leading shipper of Xenix, according to Paul Sribhibhadh, director for marketing for Microsoft's Xenix business unit. "We found IBM wasn't focusing on

C. Thatcher

Why does IBM care? Because Unix will be a major market, worth over $25 billion by 1991

Worldwide hardware sales of U.S. vendors, by operating system



Source: International Data Corp.

Xenix," he sniffs. "Now it's AIX. That'll be interesting." IBM still supports Xenix on its 16-bit PS/2 models, but has otherwise lost interest in it.

Heller says IBM dumped Xenix for purely technical reasons. AIX is "going across a much wider set of platforms than Xenix was targeted to," Heller says. "It's a much more hardened, industrial-grade system, and we have put some rather important, unique IBM features in it."

Some say IBM has included too many proprietary features. John Logan, director of research for The Yankee Group, a Boston consultancy, sees AIX as "an excellent contingency plan" for SAA, should that monstrous task take too long. More importantly, however, he thinks AIX is a strong version of Unix but is "really proprietary to IBM — AIX is only 49% Unix."

Potentially, the "proprietariness" of AIX could work in IBM's favor. Those software developers that Heller wants to write for IBM first could find themselves almost locked into AIX. Although other Unix software could move into the IBM AIX domain, any optimizations written for AIX could not move out.

But Heller says that even IBM can't mess with the standard. "You've got to remember that even if you don't like something in the Unix standard interface, you've just got to make it run better and cleaner than anyone else, but you can't go change it. You can add to it, but you can't change it," he says.

As Heller says, once the Unix interface standards are met, software moves easily between Unix flavors. And Heller maintains that IBM will keep things open. "In the sense that we can add things on, if they become useful to a large number of people, then we'll try to push them and sponsor them to be part of the standard," he says.

In fact, IBM is active in the efforts of standards bodies like the Institute of Electrical and Electronic Engineers (IEEE), which is working on Posix, a set of conformance rules to make sure everyone's Unix matches up. But IBM is very particular about which standards it supports. For instance, IBM ignores AT&T's System V interface standard (SVID). SVID actually does not specify Unix, but its close resemblance to AT&T's implementation of the operating system caused Digital Equipment Corp. to abandon a $4 billion Air Force contract bid that specified SVID. And IBM is not a member of the European Unix consortium, X/Open, even though DEC and AT&T are members. But IBM conspicuously offered its own Unix-conformance testing system to the National Bureau of Standards.

Kathleen Comiskey, a Unix specialist at International Data, says IBM's participation in committees is hardly altruistic. "It's definitely to manipulate them, to see things go as

Where goes Unix, there goes RISC

It seems that if you believe in Unix, you have to believe in RISC, or vice versa. The IBM-invented technology for reduced instruction set computing goes hand in hand with Unix — IBM's homegrown Unix was developed for its RISC workstation.

"There's nothing in Unix that inherently makes it better to run on RISC versus non-RISC," says IBM's resident RISC/Unix guru, Andrew Heller, vice president of IBM's Advanced Engineering Systems business unit. "Now, there's something in RISC that inherently makes it highly competitive. RISC, we believe, on a silicon basis, has a tremendous advantage over non-RISC architectures. And if one were to say: Gee, Unix is potentially a commodity-oriented thing, [then] price/performance is very visible."

Last summer, the RISC team was moved into IBM's Entry Systems Division, home of its personal computer efforts. IBM is starting to market its RISC machine aggressively as a small commercial multiuser system. And Heller likes to point out that there is a RISC chip in the channel system of one of IBM's mainframes. Could that spell conflict for IBM's non-RISC midsized or mainframe models? Heller replies: "Would IBM try to manage the performance that I got out of my RISC systems? The answer is: Absolutely not. My orders are to build them as fast and as inexpensively as possible."

Sun Microsystems Inc.'s CEO Scott McNealy aims to put his "Sparc" RISC chip into computers ranging in price from $1,000 to $1 million, or in "Sparcintoshes to Sparcframes." And watch out for Amdahl Corp., which clones IBM mainframes. Amdahl just so happens to be half owned by Fujitsu Ltd., the company that makes most of Sun's Sparcs, and it just signed a deal with Sun to work jointly on the next version of Unix. Not to mention that AT&T is Amdahl's biggest customer. Amdahl president E. Joseph Zemke says he's taking a long, hard look at Sun's chip for future projects. □

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much their way as they can." Adds Robert Ackerman, X/Open's chief marketing officer: "IBM says X/Open duplicates the work of the standards bodies. They're being snooty about it." IBM says it can't partcipate in a group that commits to product development before standards have been established.

John Williams, senior manufacturing project engineer at General Motors Corp., thinks IBM is waiting for results from the IEEE before making a major Unix move. Williams is on GM's Advanced Manufacturing Engineering project, headquartered in Pontiac, Mich., "My private suspicion," says Williams, "is that when Posix is set and everybody is out from under AT&T, then we'll see something," from IBM.

Others think IBM is simply dragging its feet while others test the waters. "They need other people to legitimize a market for them," says Heidi Monaco, vice president of software developer Unify Corp., and an IBM alumna. She thinks IBM's mainframe Unix efforts might pick up if arch rival Amdahl does well. While Amdahl mainframes run IBM software, president Zemke credits 15% of the company's 1987 sales to Unix.

But Paul Cubbage, a Unix watcher at San Jose market research firm Dataquest Inc., warns competitors not to dismiss IBM easily. "I would expect IBM to be one of the major players — in the top five in the 90s," Cubbage says. "If the market is big enough to get their attention and make them spend enough, the potential is there that they could be the market leader." □

A competitor's eye view of IBM's Unix

Amdahl Corp.
"I always take IBM seriously. It's only a question of time before they provide better Unix solutions."
E. Joseph Zemke, president

Sun Microsystems Inc.
"They're trying to do a proprietary environment. They don't believe in open systems . . . I would rather be competing against IBM on a Unix-to-Unix basis than on their own terms."
Scott McNealy, CEO

Hewlett-Packard Co.
"It's their way of saying: We agree. They only offer Unix as a last resort."
Douglas Speng, general manager, commercial systems

Prime Computer Inc.
"IBM is still big enough that IBM can do what IBM wants to."
Leonard Halio, vice president

Unisys Corp.
"The RT PC is isolated; it's a little wild baby . . . AIX is not part of SAA, even . . . If they are supporting Unix in Europe, it's well hidden."
Guido Vanherberghen, Unix-products manager, Europe and Africa

Altos Computer Systems
"I think it's a place-keeper. IBM intends it to say: We will not be excluded from government procurements . . . Is it really and truly marketed, or an overall strategy? The thing you have to consider is where their mainstream is."
Russell Aldrich, director for sytems software marketing

Gould Inc.
"IBM is probably going to go to Unix before DEC does. They don't have an overall operating system strategy that fits over all their hardware . . . Unix could do some of that for them . . . "
Douglas Beard, senior director for marketing, Computer Systems Division

Pyramid Technology Corp.
"In talking to VARs, I don't know if it divides up one-third, one-third, one-third, but there is an IBM world, a DEC world and a Unix world . . . For IBM, Unix is a defensive move. They'll keep it in the workstation marketplace for a fairly long period of time . . . "
Nick Tuttle, vice president for marketing

Apollo Computer Inc.
"They have a very aggressive group down in Austin . . . They have to work within the conservativeness of the company, but the potential is there . . . Anybody who writes them out of it at this point in time is foolish."
Mark Hatch, Domain products marketing manager

PERIPHERALS

Control Data cashes in on a captive operation

CDC is turning its internal expertise in thin film heads for disk drives into a thriving OEM business

For Control Data Corp., making semiconductors that fly is both an old and a new business.

For several years the Minneapolis-based company has made its own disk drive thin film read-write heads, semiconductors which replace traditional composite ferrite heads. These semiconductors "fly" about 10 millionths of an inch above a disk because they are grooved on the bottom to create the same type of aerodynamic "lift" as a wing gives an airplane.

But since 1986, CDC has moved into the original equipment manufacturer market for thin film heads, which are in demand because their output signal is superior to composite ferrite read-write heads. The stronger output signal is important because the narrower data tracks on high-capacity disks generate a weaker signal than standard-width tracks.

CDC's newfound interest in the OEM portion of the thin film head market mirrors the trend toward increased storage density on all sizes of disks, but particularly the 5.25-inch and 3.5-inch models.

While CDC doesn't disclose revenue or earnings from its thin film head business, analysts estimate that it sold about $25 million worth of thin film heads to the OEM market in 1987, while producing another $100 million worth of the heads for its own internal use.

That's a relatively small business for CDC, which had revenue of $3.3 billion in 1986. But the OEM portion represents rapid growth from 1986 OEM thin film head sales, which analysts estimate at $5 million.

The main stumbling block to the new thin film read-write head technology, however, is that it is still more expensive than the less-exotic composite ferrite head technology that relies on tiny machine-tooled magnets instead of semiconductors.

But CDC's decision to market thin film heads to the OEM market is designed to address that problem. In addition to tapping a growing market, CDC hopes to boost thin film head production in order to obtain economies of scale that should lower per-unit prices. It's a strategy not unlike the one CDC used successfully in the early 1960s, when it began OEM sales of its disk drives to competing mainframe vendors.

CDC's VICE PRESIDENT RIEGEL: "It was a dire cultural change in this division to get focused on customer requirements"

Peripheral Components International (PCI), the CDC subsidiary that handles thin film head production and sales, is much newer than the disk business. It grew out of a joint venture with Memorex Corp. in the early 1980s; CDC bought out its joint venture partner more than three years ago.

David Riegel, vice president of CDC's 5,000-employee components division, which includes PCI, says that the density requirements of smaller disks mean that thin film heads will be needed on 5.25-inch drives in the 300-megabyte to 500-megabyte range and on 3.5-inch drives with more than 100MB of storage. Thin film heads also are used on some drives using 8-, 9- and 14-inch platters, he adds.

In 1987, PCI made 3 million thin film heads and sold 20% of them to the OEM market, while 80% were used by CDC. In 1988, the company projects it will make 7 million thin film heads, and sell 40% of them to the OEM market. Peter Gove, marketing general manager of PCI, says that will give his operation "the greatest [thin film head] capacity in the industry outside of IBM."

PCI also expects to make about 5 million composite ferrite heads in 1988, but this year will mark its first venture into the OEM market with that product. Thus it is thin film heads, which have been sold to OEMs since mid-1986, to which PCI is looking for sharp sales increases this year, Riegel says.

Despite the sharp decline in the stock market in late 1987, and the resulting jitters in the business world, PCI sees no reason to reduce its sales expectations for 1988. "We've got firm purchase orders through the middle of 1988 that absolutely use our capacity," Riegel says. Adds Gove: "For the second half of the year we have high confidence in our estimates."

Riegel says his operation will benefit from a built-in multiplier factor as sales of smaller disk drives increase. While today's lower capacity 5.25-inch drives use as few as six thin film heads each, a 5.25-inch drive with a capacity of 380MB requires eight platters and 16 thin film heads, he says.

But to take advantage of a growing market, CDC has had to invest about $10 million in PCI in the last year, boosting its total investment in the subsidiary to about $60 million since 1983, Riegel says.

At the same time, PCI had to change marketing attitudes inside CDC while convincing disk drive manufacturers that it wouldn't reveal

their product plans to CDC's own drive designers.

"It was a dire cultural change in this division to get focused on customer requirements" after years of being a captive head manufacturer, Riegel says.

To win customers, he adds, "you have to be able to demonstrate to them that you manage the [disk and head] businesses separately and that there will be no information transfer, that you will protect their proprietary information."

Gove says that convincing customers PCI will honor their secrets "is the toughest challenge we've got."

Dennis Waid, an analyst with Peripheral Research Corp. of Santa Barbara, Calif., says CDC and other suppliers of thin film heads are benefiting from a shortage that is expected to continue until at least the end of 1988.

While PCI's disadvantage is that it is part of a large diverse company instead of being focused solely on heads as its competitors are, Waid says, "for the time they've been in business they've done a fairly good job." In addition to being "in the right place at the right time, [PCI] has probably got more experience in thin film heads than anybody except IBM," he says.

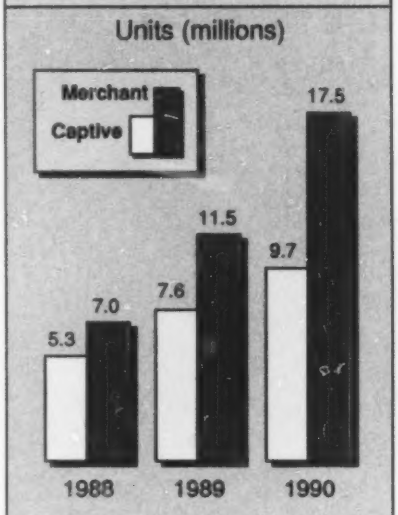
Thin film heads were used in 12.9% of the total non-IBM hard disks sold in 1987, Waid says. By 1990, that number is expected to grow to 35%. Driving that growth is the ability of thin film heads to read 30,000 to 35,000 bits per inch; and about 2,500 to 3,000 tracks per inch; compared to composite ferrite heads which can read 16,000 to 18,000 bits per inch; and about 1,300 tracks per inch.

In 1987, Waid says, CDC marketed about 33% of the $36 million worth of thin film heads sold to the OEM market (which excludes the huge internal consumption of CDC and IBM.) Competitor Read-Rite Corp. of Milpitas, Calif., had 32% of the market last year, while another contender, Applied Magnetics Corp. of Goleta, Calif., had 30%, he adds. Small manufacturers divided up the remaining 5% of the market.

The OEM market for thin film heads will reach $115 million in 1988, Waid predicts. That won't include a significant presence by the Japanese, who are heavily committed to ferrite head technology, he adds.

But Riegel says he's expecting Japanese thin film head manufacturers to expand into the U.S. market, where

OEM market for thin-film heads outpaces captive needs



Source: Peripheral Research Corp.

Panasonic and TDK have done some initial testing of the waters. "They'll be there. We expect it, and we expect that they'll be formidable competitors."

CDC won a big victory this year when Read-Rite suffered process control problems in its thin film head manufacturing and couldn't meet the needs of Maxtor Corp. of San Jose. Robert Teal, senior marketing and

The main stumbling block to the new thin film read-write technology is that it is still more expensive than composite ferrite heads

sales vice president at Maxtor, says his firm turned to PCI to take over as its main supplier, and signed a contract that will have a value of about $35 million through the middle of 1989. "I really don't know how you could do a 760MB drive without thin film technology," he adds.

Teal says Maxtor needed a vendor that could provide reliability, consistency and a relatively low cost per unit. "PCI is better positioned than other folks to provide all those parameters because of their large investment in capital equipment" and because CDC's combined OEM and internal production helps reduce the cost per head, he says.

Riegel agreed. "We took advantage of supply constraints that occurred" in early 1987, he says. "I think production will catch up with demand, but . . . it's not clear that production will catch up in 1988."

Dundas Flaherty, chief financial officer for Micropolis Corp. of Chatsworth, Calif., says there is indeed "a temporary insufficiency of supply of thin film heads, but it's hard to say when supply will catch up with demand." Micropolis also is a PCI customer, he says, "but I hesitate to say more than that."

But Riegel says one problem facing the business is that the thin film heads still cost more than the insect-sized composite ferrite heads made with machine tools. As a result, the OEM market for thin film heads isn't as big as it might be, he adds.

While Gove projected that prices will go down as production volume increases, by 1989 thin film heads still will cost about $13 each in quantities of hundreds of thousands. Waid says that's more expensive than composite ferrite heads, which in late 1987 cost from $8 to $10 each in similar quantities.

Waid says thin film heads remain more expensive because of the unique technical problems involved with making them fly, such a short distance above the disk, 10 millionths of an inch compared to 12 millionths to 16 millionths for a composite ferrite head. The machining process that is used to give the finished semiconductors wing-like undersides isn't perfected, he says, and as many as half the thin film heads may be so flawed that they must be discarded.

That's far below the yields typically obtained in the semiconductor-manufacturing process, and means that the machining part of thin film head production acts as a bottleneck in obtaining the higher yields that could result in lower prices, Waid says. The reduced yields result in higher prices for the usable thin film heads, he adds.

"Theoretically, thin film head design . . . allows you to produce lots of them once your [semiconductor] manufacturing process is up," he adds. "But the problem is that the [machining] yields have never been high enough that they paid off."

Adds Riegel: "The yield challenge is always there."

STEVE GROSS

Skip the front page, and ignore recession talk

They make you lose sight of what's important: That the electronics industry is outperforming the economy again

By Alberto Socolovsky

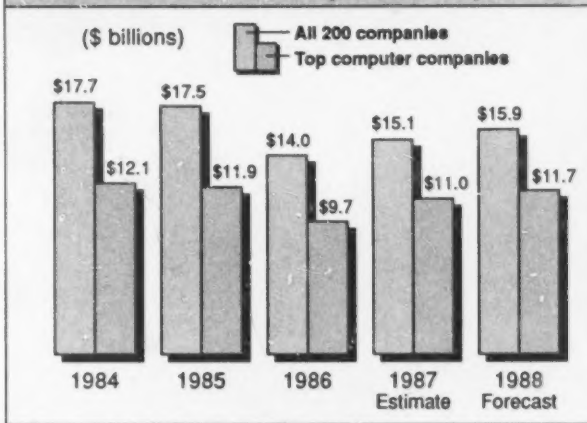
We usually report in the pages of ELECTRONIC BUSINESS, most often interpret, generally encourage, but rarely admonish. This is the time for a gentle, but not less sad, admonition: When reading *The Wall Street Journal*, that excellent business daily, skip the front page. Those front page stories on the odds for a recession are getting to you.

We can tell that from a recent survey of our readers' plans for capital investment in 1988. Our study, conducted right after the stock market crash of last October, reveals the negative impact the crash had, even when most of the electronics industry was wrapping up 1987 on a very upbeat trend. While the psychological effects of the crash are slowly wearing off, they rekindle every time you see a story quoting this or that economist's opinion on the likelihood for an economic recession. Even if there is one, the electronics industry will outperform it. But you will miss the opportunities that a growing industry will offer, if recession talk dissuades you from gearing up your company for international competition.

Our survey reveals that our readers plan to invest about 5% more dollars this year than last, but they don't plan an increase in investment as a percentage of sales. That is, even after the crash, you plan for 1988 as a year of more sales — why not, then, for more investment? There is, however, an encouraging trend in the survey. Most of the investment, 74%, will be in the United States, and primarily — 56% — for manufacturing equipment. Of the investment abroad, most will be in Mexico, followed by Singapore, Western Europe, Taiwan and Malaysia.

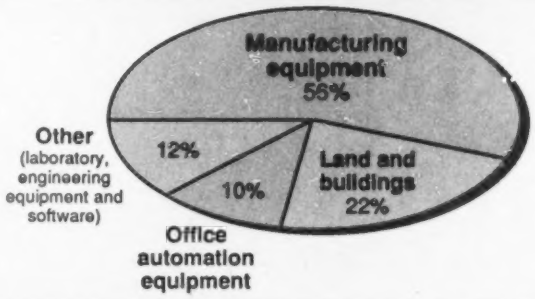
To be sure, many American electronics companies, particularly the computer companies that, like Digital Equipment Corp., Hewlett-Packard Co. and IBM, are committed to manufacturing. They have kept up their investment and will reap the rewards in increased international competitiveness. It's just that their example is not spreading fast enough, even though it is far more instructive and enlightening than all the front page articles about an economics doomsday. □

Capital investment by the top 200 electronics and computer companies



Source: The ELECTRONIC BUSINESS 200

Manufacturing equipment gets most of the 1988 investment



Source: ELECTRONIC BUSINESS survey